DOCUMENT RESUME

ED 157 508 IR 006 011

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TITLE A Comparison of Interactive and Non-Interactive Audio-Visual Programs. Applied Educational Research and Evaluation Module.
PUB DATE Feb 78
NOTE 18p.; Ph.D. practicum, Nova University

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Audiovisual Aids; *Audiovisual Instruction; *Autoinstructional Aids; Comparative Analysis; Media Research; Post Secondary Education; Vocational Education

ABSTRACT

This study was undertaken to determine if the instructional quality of audiovisual materials is improved when student self-tests are included in the program. Two sound/slide programs on reading line graphs were tested on one-year vocational students at Forsyth Technical Institute, North Carolina. Twenty students in the experimental group used interactive material with self-tests mixed into the program. The control group of 26 students used an identical program without interactive material. All students took the same post-test based on the objectives of the program; these were lower-level cognitive objectives. The test scores were compared using a t-test (two tailed). The post-test results indicated that the experimental group achieved a higher percentage of program objectives at the 5% level of significance. The advantage was so narrow, however, and the limitations of the study so numerous, that further study was recommended. (VT)

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A COMPARISON OF INTERACTIVE AND NON-INTERACTIVE AUDIO-VISUAL PROGRAMS

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WINSTON-SALEM CLUSTER

A PRACTICUM PRESENTED TO NOVA UNIVERSITY
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF EDUCATION

NOVA UNIVERSITY

FEBRUARY 1978

IR006011

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ABSTRACT

This study was undertaken to determine if the instructional quality of audio-visual materials is improved when student self-tests are included in the program.

Two sound/slide programs were tested on a sample of one-year vocational students at Forsyth Technical Institute (Winston-Salem, North Carolina). The programs were identical except that one contained student self-tests, or interactive material, mixed into the program and the other did not. The experimental group used the program with the interactive component. The control group used the ordinary program. All students took the same post-test based on the objectives of the program.

The post-test results indicated that the program with the interactive component did a better job, by a slight margin, than did the ordinary program. The advantage was so narrow and the limitations of the study so numerous that the recommendation was that further study be made.

A COMPARISON OF INTERACTIVE AND NON-INTERACTIVE AUDIO-VISUAL PROGRAMS

I. PROBLEM

The effectiveness of audio-visual programs as instructional materials is dependent upon several factors. These factors relate to the preparedness of the student to learn, the quality of the program, and the conditions under which the student uses the program. The latter two are related in that the characteristics of the program can affect the conditions under which the student uses it. The student can be a physically passive observer of the program or he can be a physically and mentally active participant in the learning process.

This study compared the instructional effectiveness of two types of audio-visual programs: interactive and non-interactive. The variables of learning and program type were examined to see if they are related.

II. HYPOTHESIS

It was expected that the results of this study would show that interactive audio-visual programs cause a higher percentage of program objectives to be achieved than do non-interactive programs.

The null hypothesis was that there is no significant difference between the percentage of program objectives achieved by interactive and non-interactive audio-visual programs.

III. BACKGROUND AND SIGNIFICANCE

This study was conducted with post-secondary vocational students

at Forsyth Technical Institute (Winston-Salem, North Carolina). This student is in a relatively new and often neglected segment of education. The need for instructional materials for related courses (English, mathematics, physical science) in vocational curriculums is largely neglected by commercial publishers. As a result, the student is often subjected to instructor-developed materials.

Audio-visual programs are an increasingly important type of instructional material. They are becoming essential parts of courses that allow for individual differences in learning rates and experiential learning. They are already essential parts of courses that permit open-entry and open-exit and allow for differing student learning styles. Audio-visual programs also have the capacity of helping students to learn despite reading difficulties.

The general acceptance of the educational benefits of audio-visual programs is apparent from recent program development. Television series such as The Ascent of Man and The Age of Uncertainty have made what would have been difficult and, for some, uninteresting reading into enjoyable, informative viewing and listening. After having been broadcast by public television stations, these programs have become available for classroom use.

The frequency of publically-funded projects which include audio-visual program development has increased. Recent developments in North Carolina include the Electrical Technology Project (Simmons, 1975), The North Carolina Rural Renaissance Project (Moretz, 1977), and the Vocational-Technical Physics Project (Parsons, 1976). All of these are primarily concerned with, or depend upon, audio-visual programs.

Although audio-visual programs can supplement or replace traditional classroom teaching, they have some shortcomings. It was the

contention here that a serious defect of most audio-visual programs is their lack of facility for student interaction. A type of interaction possible in an audio-visual program is the self-test. A written response is solicited from the student and then the correct answer is supplied. A feedback system such as this enables the student to assess his understanding of the material and better utilize the repeat option inherent in audio-visual programs. In light of the increasing reliance on audio-visual programs, it seems desirable to maximize the effectiveness of those programs.

A review of the literature indicates that self-instructional materials are still new to education. The form and content of those materials are dictated more by common sense and intuition than research. Skinner (1958), writing on the topic of teaching machines, recommended that students be required to compose responses frequently during an instructional program. Rothkopf (1963:120), reporting on research done from 1960 through 1963, indicates that, with few exceptions, "These investigators have not found any substantial differences between the effectiveness of programs that require written responses and comparable programs which do not." He concludes, however (p. 130), that there is ". . . A serious question as to where gross comparisons of programing strategies that employ responses with those that do not can ever yield useful results."

The case for interaction is supported by Lunsdaine (1963:587) who notes that ". . . To acquire new stimulus-response contingencies, the responses to be learned must occur in some form during the course of learning. . . . " Experimental support for the importance of student interaction comes from a report by Travers (1969). A study was made of

the learning of students who interacted with the instructor and of students who passively observed the performance of the interacting students. The students who interacted performed better on the items on which they interacted and on the items which they learned by observation. Travers interpretation of the data (p. 148) is that ". . . The direct interaction procedure raises the level of arousal of the direct students which, in turn, influences acquisition on the items which they learn by observation."

In the most recent study found, Jones (1976) reports on the advantage of self-test items. Medical students were tested after using one of three versions of the same sound/slide program. The first contained no self-test questions, the second had test items interspersed throughout the program, and the third had the test items grouped at the end of the program. It was found that the test performance was best for the group using the third program and that both the second and third were better than the first. Student opinion of self-test items is revealed in a study by Jones and Curran (1974, cited in Jones, 1976). Eighty-five percent of the students considered the presence of questions in the programmes, together with immediate feedback of correct answers, helped them to learn the subject.

The literature suggests that the value of an interactive component in an audio-visual program, although intuitively sound, cannot be inferred without regard to the educational setting and the student involved. Recent research, although limited, reports positive results with interactive components. The students involved in the studies were medical students and the results may not be applicable to post-secondary vocational students.

IV. DEFINITION OF TERMS

Audio-visual program - a pre-recorded instructional program using any combination of audible and visual mediums. Some examples are tape recording/slide, tape recording/printed page, television, and 16 mm film with sound.

Interactive - descriptive of an audio-visual program that provides for certain student activities during the use of the program. The use of the term here will be limited to programs that require the answering of questions presented in the program. The questions are designed to help the student to guage his understanding of the material but are not identical to questions on the program post-test. A complete description of the interactive component of the program used in this study is in Appendix B.

Program objectives - the measurable learning objectives of an audio-visual program. A list of the objectives of the program used in this study is in Appendix A.

Vocational students - students in a one-year, post-secondary, diploma curriculum such as automotive mechanics or welding.

V. LIMITATIONS OF THE STUDY

The primary limitation of this study was with the type of instructional objectives involved. The program had only lower level cognitive objectives. The results may not be applicable to programs with higher level cognitive objectives or with objectives in the affective domain.

The students participating in this study were selected from those vocational students enrolled in an applied science course in the winter quarter of 1977. Students in vocational curriculums which do not take an applied science course or do not take one during the winter quarter

had no opportunity to participate. Since counseling procedures can cause certain student characteristics to be unequal among curriculums, the results may not be applicable to all vocational curriculums.

The results of this study was based on audio-visual programs in the sound/slide format. One program required thirteen minutes to complete while the other required fifteen minutes. The results may not be applicable to longer programs using other mediums.

VI. BASIC ASSUMPTIONS

With regard to the students involved in this study, the assumptions were made that the groups had equal abilities to achieve the program objectives and that they were typical of post-secondary vocational students in all respects. For the purposes of the statistical treatment used, it was also assumed that the test scores from both the experimental and control groups were normally distributed.

VII. PROCEDURES FOR COLLECTING DATA

The students involved in this study were selected from the approximately ninety vocational students enrolled in an applied science course during the winter quarter. After the drop-add period, the student course cards (one per student) were gathered and numbered consecutively beginning with one. A table of random numbers was used to select forty cards (students) for the experimental group. The remainder of the students made up the control group.

The audio-visual programs used were identical except for the interactive component. The experimental group used a sound/slide program entitled Reading Line Graphs. The control group used the same program

with the interactive component deleted. Slides were removed and the tape cassette edited to modify one copy of the program.

The students were assigned as an extra-credit project to use their respective program in the Individualized Learning Center where they had control over the program pace and the option of repeating any part of the program. The Individualized Learning Center staff had a list of the students in each group and issued the appropriate program to each student. Each student, immediately after using the program, took a post-test. It was a written test based on the objectives of the program. A copy of the post-test is in Appendix C. All tests were graded in a consistent manner by the same person.

VIII. PROCEDURES FOR TREATING DATA

The data consisted of test scores from the experimental group and the control group. The test scores were compared using Student's t-test (two-tailed). This test for the significance of the difference between independent means was used because of its value, according to Li (1964), in testing the null hypothesis that two samples are from the same population.

A program for computing the t statistic from the following formula was used with a Hewlett-Packard Model 9810 calculator.

$$t = \frac{1}{\sqrt{\frac{1}{N_1} + \frac{1}{N_2}}} \quad \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sum X_1^2 + \sum X_2^2}{N_1 + N_2 - 2}}}$$

The null typothesis was tested to the five percent level of significance. A lower level would have been difficult to justify since the test instrument had not been tested for reliability and the students

involved were not chosen from a true cross-section of all vocational students. A larger level of significance would have increased the probability of making a type I error (rejecting a true hypothesis). Considering the recommendations that would follow the rejection of the null hypothesis, a type I error would lead to a great deal of wasted effort on the part of instructional materials designers.

IX. RESULTS

Only about one-half of the students in applied science classes elected to participate in the study. Twenty students from the experimental group used the program with the interactive component. Twenty-six students from the control group used the program without the interactive component. The value of the t statistic necessary to reject the null hypothesis to the five percent level of significance with forty-four degrees of freedom is 2.02.

The experimental group had a mean test score of 76.0 percent correct with a standard deviation of 16.5. The control group had a mean test score of 73.7 percent correct with a standard deviation of 18.8. The t statistic calculated was 5.86. Therefore, the null hypothesis can be rejected. The interactive audio-visual program did cause a higher percentage of program objectives to be achieved than did the non-interactive program.

X. CONCLUSIONS AND SIGNIFICANCE

The null hypothesis that there is no significant difference between the percentage of program objectives achieved by interactive and non-interactive audio-visual programs was rejected. The implication is that sound/slide programs work better with an interactive component

mixed into the program. It should be noted again here that the programs tested were short-time-length with only lower level cognitive objectives. However, the small difference of only 2.3 percent between the groups' mean scores does not suggest a strong superiority of the interactive program. Further research is needed to control more variables and eliminate some of the limitations of this study.

Several questions need answers if audio-visual programs are to achieve their maximum effectiveness. Would a self-test at the end of a program be as effective as mixing self-test questions into the program? Would interactive components make a larger improvement in programs lasting thirty or forty-five minutes? Are the results of this study applicable when the objectives are on a higher cognitive level or in the affective domain? Are interactive components an advantage in other audio-visual mediums?

These questions must be answered if the trend toward increased reliance upon audio-visual materials is to be guided by facts rather than intuituion and expediancy. A significant investment in equipment, expertise and time is required to produce poor programs or to produce and misuse good programs. The same investment can result in good programs used to their maximum effectiveness. As we exploit the advantages offered by the use of audio-visual materials, we must determine what program characteristics work best in any given situation.

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APPENDIX A

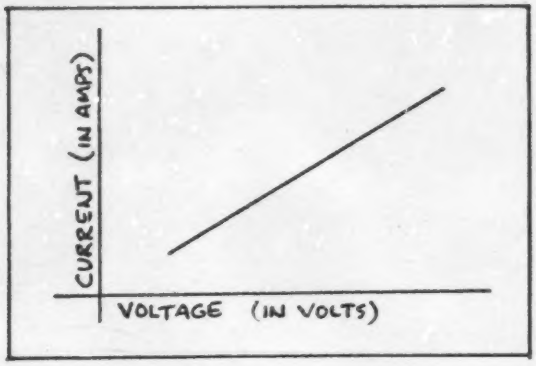
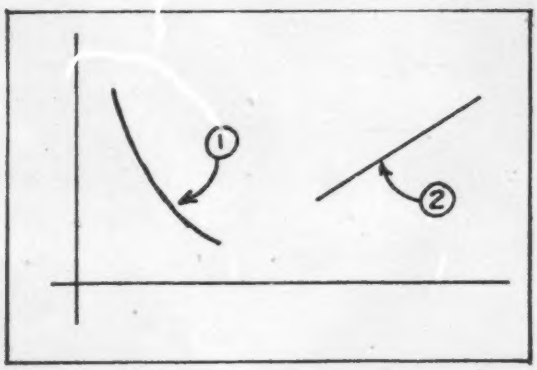
OBJECTIVES OF READING LINE GRAPHS

After completing the sound/slide program, Reading Line Graphs, the student should be able to look at a line graph and:

1. name the quantities that are being compared;
2. identify the independent and dependent quantities;
3. determine if the relationship is linear or non-linear;
4. determine if the quantities are directly related or inversely related;
5. name the value of the smallest scale division; and
6. given the value of one quantity, read the corresponding value of the other quantity.

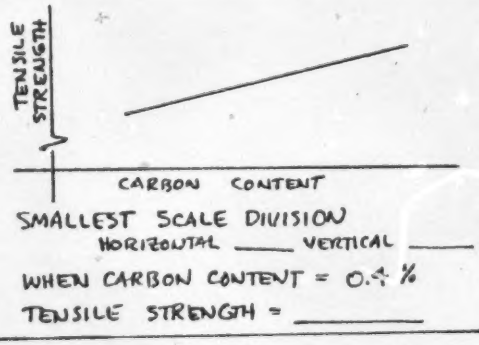
APPENDIX B

INTERACTIVE COMPONENT OF READING LINE GRAPHS

	DESCRIPTION OF VISUAL	SCRIPT OF AUDIO
16		Look at this graph and determine what quantities are being compared. Which is the independent quantity and which is the dependent quantity? Write down your answers. (music - 20 seconds)
17	SAME AS SLIDE NO. 16 BUT WITH OVERLAYS AND LABELS FOR "INDEPENDENT" AND "DEPENDENT"	The quantities being compared are voltage and current. Voltage is the independent quantity and current is the dependent quantity. (5 second pause)
29		For each of the lines on this graph determine whether the relationship is linear or non-linear. Also determine if it represents a direct proportionality or an inverse proportionality. Write down your answers. (music - 25 seconds)

APPENDIX B (CONTINUED)

INTERACTIVE COMPONENT OF READING LINE GRAPHS

	DESCRIPTION OF VISUAL	SCRIPT OF AUDIO
30	SAME AS SLIDE NO. 29 BUT WITH ANSWERS INSERTED	Line number one is non-linear and represents an inverse proportionality. Line number two is linear and represents a direct proportionality. (5 second pause)
42		Look at the scales on this graph. Determine the value of the smallest division on the horizontal and on the vertical axes. Also read the value of tensile strength when the carbon content is four tenths of one percent. Write down your answers. (music - 30 seconds)
43	SAME AS SLIDE NO. 42 BUT WITH ANSWERS INSERTED	On the horizontal axis the smallest division is point zero two percent. On the vertical axis the smallest division represents 5000 pounds per square inch. When the carbon content is four tenths of one percent, the tensile strength is 70,000 pounds per square inch. (5 second pause)

READING LINE GRAPHS - TEST NAME _____

Look at the graph below and answer the following questions.

1. The quantities being compared are _____ and _____.
2. The independent quantity is _____.
3. The relationship is _____. (linear or non-linear)
4. The quantities are _____ proportional. (directly or inversely)
5. The value of the smallest division on the vertical scale is _____.
6. When the force is 200 newtons, the stretch is _____ centimeters.